

WHAT IS CLAIMED IS:

1 1. A process for synthesizing photocurable  
2 poly(ethynyl)carbosilane comprising the steps of:  
3 a. mixing dichlorosilane and trichlorosilane reagents;  
4 b. adding sub-stoichiometric amounts of alkali metal; and  
5 c. adding excess sodium acetylide.

6

7 2. A process for synthesizing photocurable  
8 poly(ethynyl)carbosilane comprising the steps of:  
9 a. mixing dichlorosilane and trichlorosilane reagents in the  
10 presence of methylene bromide;  
11 b. adding sub-stoichiometric amounts of alkali metal; and  
12 c. adding excess sodium acetylide.

13

14 3. A process for synthesizing photocurable poly(ethynyl)  
15 carbosilane comprising the steps of:  
16 a. mixing dichlorosilane and trichlorosilane reagents in the  
17 presence of methylene bromide;

1 b. adding sub-stoichiometric amounts of sodium metal; and  
2 c. adding excess sodium acetylide.

3

4 4. A process for synthesizing photocurable poly(ethynyl)  
5 carbosilane comprising the steps of:  
6 a. mixing dichloromethylsilane and trichlorophenylsilane  
7 reagents in the presence of methylene bromide;  
8 b. adding sub-stoichiometric amounts of sodium metal; and  
9 c. adding excess sodium acetylide.

10

11 5. A process for synthesizing photocurable poly(ethynyl)  
12 carbosilane comprising the steps of:  
13 a. mixing dichloromethylsilane and trichlorophenylsilane  
14 reagents in the presence of methylene bromide;  
15 b. adding sub-stoichiometric amounts of molten sodium metal  
16 under flowing argon gas; and  
17 c. adding excess sodium acetylide dissolved in dimethyl  
18 formamide.

1 6. A process for synthesizing photocurable poly(ethynyl)  
2 carbosilane comprising the steps of:  
3 a. forming a dispersion of sub-stoichiometric amounts of  
4 alkali metal;  
5 b. adding dichlorosilane and trichlorosilane reagents; and  
6 c. adding excess sodium acetylide.

7  
8 7. A process for synthesizing photocurable poly(ethynyl)  
9 carbosilane comprising the steps of:  
10 a. forming a dispersion of sub-stoichiometric amounts of  
11 molten sodium metal in a solvent;  
12 b. adding dichlorosilane and trichlorosilane reagents; and  
13 c. adding excess sodium acetylide.

14  
15 8. A process for synthesizing photocurable poly(ethynyl)  
16 carbosilane comprising the steps of:  
17 a. forming a dispersion of sub-stoichiometric amounts of  
18 molten sodium metal in a solvent;

1 b. adding dichloromethylsilane and trichlorophenylsilane

2 reagents; and

3 c. adding excess sodium acetylide in dimethylbromide.

4

5 9. A process for synthesizing photocurable poly(ethynyl)

6 carbosilane comprising the steps of:

7 a. forming a dispersion of sub-stoichiometric amounts of

8 molten sodium metal in xylene;

9 b. adding dichloromethylsilane and trichlorophenylsilane

10 reagents; and

11 c. adding excess sodium acetylide in dimethylbromide.

12

13 10. A process for synthesizing photocurable poly(ethynyl)

14 carbosilane comprising the steps of:

15 a. forming a dispersion of sub-stoichiometric amounts of

16 molten sodium metal in xylene;

17 b. adding dichloromethylsilane and trichlorophenylsilane

18 reagents;

1 c. filtrating insoluble by-products;  
2 d. evaporating xylene solvent from poly(chloro)carbosilane  
3 polymer;  
4 e. dissolving said aforementioned polymer in tetrahydro  
5 furan; and  
6 f. adding excess sodium acetylide dissolved in dimethyl  
7 bromide.

8  
9 11. A process of forming a photo-curable pre-ceramic  
10 polymer, poly(ethynyl)-carbosilane to silicon carbide  
11 ceramic comprising the steps of:  
12 a. reacting sodium acetylide with organo-chlorosilanes;  
13 and  
14 b. condensing (polymerizing) the resultant organo-  
15 (ethynyl)chlorosilane product of step a with an excess  
16 of an alkali metal.

17 12. A process of forming a photo-curable pre-ceramic

1 polymer, poly(ethynyl)-carbosilane to silicon carbide  
2 ceramic comprising the steps of:  
3 a. reacting sodium acetylide with organochloro-silanes;  
4 and  
5 b. condensing (polymerizing) the resultant organo-  
6 ethynyl)chlorosilane product of step a with an excess of  
7 an alkali metal sodium.

8 13. A process of forming a photo-curable pre-ceramic  
9 polymer, poly(ethynyl)-carbosilane, to silicon carbide  
10 ceramic comprising the steps of:  
11 a. reacting sodium acetylide with a mixture of  
12 organodichlorosilanes and organotrichlorosilanes;  
13 and  
14 b. condensing (polymerizing) the resultant organo  
15 (ethynyl)-chlorosilane product of step a with an excess  
16 of an alkali metal.

1 14. A process according to claim 1 in which the organo  
2 chlorosilane is selected from a group of one or more of the  
3 following: dichlorodimethylsilane, trichloro-phenylsilane  
4 (tri-functional), and methyltrichlorosilane.

5  
6 15. A process of forming a photo-curable pre-ceramic  
7 polymer, poly(ethynyl)-carbosilane to silicon carbide  
8 ceramic comprising the steps of:

9 a. reacting a sub-stoichiometric amount of an alkali metal  
10 with organochloro-silanes; and  
11 b. reacting the partially polymerized polyorganochloro-  
12 silane with sodium acetylide.

13  
14 16. A process of forming a photo-curable pre-ceramic  
15 polymer, poly(ethynyl)- carbosilane to silicon carbide  
16 ceramic comprising the steps of:

17 a. reacting a sub-stoichiometric amount of sodium metal  
18 with organochlorosilanes; and

1 b. reacting the partially polymerized polyorganochloro-  
2 silane with sodium acetylide.

3  
4 17. A process of forming a photo-curable pre-ceramic  
5 polymer, poly(ethynyl)carbosilane to silicon carbide ceramic  
6 comprising the steps of:

7 a. reacting a sub-stoichiometric amount of an alkali  
8 metal with a mixture of organodichlorosilanes and  
9 organotrichlorosilanes; and  
10 b. reacting the partially polymerized polyorgano-  
11 chlorosilane with sodium acetylide.

12  
13 18. A process according to claim 5 in which the  
14 organochlorosilane is selected from a group consisting  
15 of one or more of the following: dichlorodimethylsilane,  
16 trichlorophenylsilane (tri-functional), and  
17 methyltrichlorosilane.

18

1 19. A process of forming a photo-curable pre-ceramic  
2 polymer, poly(ethynyl)silazane, to silicon nitride ceramic  
3 comprising the steps of:

- 4 a. reacting sodium acetylide with organochlorosilanes;
- 5 and
- 6 b. condensing (polymerizing) the resultant organo-
- 7 (ethynyl)chlorosilane product of step a with ammonia.

8  
9 20. A process of forming a photo-curable pre-ceramic  
10 polymer, poly(ethynyl)-silazane to silicon nitride ceramic  
11 comprising the steps of:

- 12 a. reacting sodium acetylide with organochloro-
- 13 silanes; and
- 14 b. condensing (polymerizing) the resultant organo-
- 15 (ethynyl) chlorosilane product of step a with ammonia.

16  
17 21. The process of preparing photocurable CERASETTM SZ  
18 inorganic polymer comprising the step adding a photo-

1 initiator to CERASETTM SZ inorganic polymer.

2

3 22. The process of claim 21, in which said photo-initiator  
4 is Camphorquinone.

5

6 23. The process of claim 21 in which said photo-initiator is  
7 IRGACURE® 1800.

8

9 24. The process of preparing photocurable allylhydrido-  
10 polycarbosilane polymer comprising the step of adding a  
11 photo-initiator to allylhydridopolycarbosilane polymer.

12

13 25. The process of claim 24, in which said photo-initiator  
14 is Camphorquinone.

15

16 26. The process of claim 24, in which said photo-initiator  
17 is IRGACURE® 1800.

18

1 27. A process of forming a photo-curable pre-ceramic  
2 polymer, poly(ethynyl)silazane, to silicon nitride ceramic  
3 comprising the steps of:  
4 a. reacting sodium acetylide with a mixture of organo-  
5 dichlorosilanes and organotrichlorosilanes; and  
6 b. condensing (polymerizing) the resultant organo-  
7 (ethynyl)chloro-silane product of step a with ammonia.

8  
9 28. A process according to claim 27 in which the  
10 organochlorosilane is selected from a group consisting of  
11 one or more of the following: dichlorodimethylsilane,  
12 trichlorophenylsilane (tri-functional) and methyltri-  
13 chlorosilane.

14  
15 29. A process of forming a photo-curable pre-ceramic  
16 polymer, poly(ethynyl)-silazane to silicon nitride ceramic  
17 comprising the steps of:  
18 a. reacting a sub-stoichiometric amount of ammonia

with organo-chlorosilanes; and

2 b. reacting the partially polymerized polyorgano  
3 chlorosilazane with sodium acetylide.

5 30. A process of forming a photo-curable pre-ceramic.  
6 polymer, poly(ethynyl)-silazane to silicon nitride ceramic  
7 comprising the steps of;

8 a. reacting a sub-stoichiometric amount of ammonia  
9 with organo-chlorosilanes; and  
10 b. reacting the partially polymerized polyorgano  
11 chlorosilazane with  
12 sodium acetylide.

14 31. A process of forming a photo-curable pre-ceramic  
15 polymer, poly(ethynyl)-silazane to silicon nitride ceramic  
16 comprising the steps of:

17 a. reacting a sub-stoichiometric amount of ammonia  
18 with a mixture of organodichlorosilanes and

1 organotrichlorosilanes; and

2. b. reacting the partially polymerized polyorganochlorosilazane with sodium acetylide.

5 32. A process for fabricating a ceramic matrix composites  
6 comprising the steps of:

7 a. preparing a solution of thermoplastic photo-curable  
8 pre-ceramic polymer;  
9 b. passing a pre-preg through said solution of  
10 thermoplastic photo-curable pre-ceramic polymer;  
11 c. applying said pre-preg to a shaped mandrel;  
12 d. using light energy to induce cross-linking of said  
13 photo-curable pre-ceramic polymer after application to  
14 said mandrel whereby said thermoplastic pre-ceramic  
15 polymer is curved; and  
16 e. pyrolyzing said cured thermoplastic pre-ceramic  
17 polymer matrix composite material.

1 33. A single-step fabrication of continuous ceramic fiber  
2 ceramic matrix composites employing a thermoplastic  
3 photo-curable pre-ceramic polymer in which the component is  
4 shape by a variety of standard composite fabrication  
5 techniques, such as filament winding, tape winding, and  
6 woven cloth winding comprising steps of:  
7 a. passing ceramic fiber monofilament, tow, mat, or  
8 woven cloth through a solution of said thermoplastic  
9 photo-curable pre-ceramic polymer;  
10 aa. applying ceramic fiber monofilament, tow, mat, or  
11 woven cloth to a shaped mandrel;  
12 bb. using photo-energy of the ultraviolet, visible or  
13 infrared light spectrum to induce cross-linking  
14 (curing) of the photo-curable pre-ceramic polymer  
15 after application to said mandrel; and  
16 cc. either partially or completely pyrolyzing the now  
17 cured pre-ceramic polymer matrix composite  
18 material.

1 35. A process for synthesizing ceramic matrix composites  
2 according to claim 34 in which the pre-ceramic polymer is  
3 poly(ethynyl)carbosilane.

4  
5 36. A process for synthesizing ceramic matrix composites  
6 according to claim 34 in which the pre-ceramic polymer  
7 yields silicon carbide upon pyrolysis.

8  
9 37. A process for synthesizing ceramic matrix composites  
10 according to claim 34 in which the pre-ceramic polymer  
11 yields an oxide ceramic upon pyrolysis.

12  
13 38. A process for synthesizing ceramic matrix composites  
14 according to claim 34 in which the pre-ceramic polymer  
15 yields titanium carbide upon pyrolysis.

16  
17 39. A process for synthesizing ceramic matrix composites  
18 according to claim 34 in which the pre-ceramic polymer

1 yields aluminum nitride upon pyrolysis.

2

3 40. A process for synthesizing ceramic matrix composites  
4 according to claim 34 in which the pre-ceramic polymer  
5 yields silicon nitride upon pyrolysis.

6

7 41. A process for synthesizing ceramic matrix composites  
8 according to claim 34 in which the pre-ceramic polymer  
9 yields aluminum oxide upon pyrolysis.

10

11 42. Single-step fabrication of continuous ceramic fiber  
12 ceramic matrix composites employing a thermoplastic  
13 photo-curable pre-ceramic polymer in which the component is  
14 shaped by a variety of standard composite fabrication  
15 techniques, such as filament winding, tape winding, and  
16 woven cloth winding under inert atmosphere comprising steps  
17 of:

18 a. passing ceramic fiber monofilament, tow, mat, or

1 woven cloth through a solution of said thermoplastic  
2 photo-curable pre-ceramic polymer;  
3 b. applying ceramic fiber monofilament, tow, mat, or  
4 woven cloth to a shaped rotating mandrel;  
5 c. use of a heated or unheated compaction roller to  
6 press the thermoplastic pre-ceramic polymer onto the  
7 mandrel;  
8 d. using ultraviolet, visible, or infrared light to  
9 induce cross-linking (curing) of the photo-curable pre-  
10 ceramic polymer thereby rendering a thermoset polymer;  
11 e. either partially or completely pyrolyzing the now  
12 cured pre-ceramic polymer matrix material; and  
13 f. followed by the final heat treatment of the shaped  
14 ceramic matrix composite "brown body".

15  
16 43. A process for synthesizing ceramic matrix composites  
17 according to claim 42 in which the pre-ceramic polymer is  
18 poly(ethynyl)carbosilane.

1 44. A process for synthesizing ceramic matrix composites  
2 according to claim 42 in which the pre-ceramic polymer  
3 yields an oxide ceramic upon pyrolysis.

4  
5 45. A process for synthesizing ceramic matrix composites  
6 according to claim 42 in which the pre-ceramic polymer  
7 yields silicon nitride upon pyrolysis.

8  
9 46. A process for synthesizing ceramic matrix composites  
10 according to claim 42 in which the pre-ceramic polymer  
11 yields titanium carbide upon pyrolysis.

12  
13 47. A process for synthesizing ceramic matrix composites  
14 according to claim 42 in which the pre-ceramic polymer  
15 yields aluminum nitride upon pyrolysis.

16  
17 48. A process for synthesizing ceramic matrix composites  
18 according to claim 42 in which the pre-ceramic polymer

1 yields silicon carbide upon pyrolysis.

2  
3 49. A process for synthesizing ceramic matrix composites  
4 according to claim 42 in which the pre-ceramic polymer  
5 yields aluminum oxide upon pyrolysis.

6  
7 50. Single-step fabrication of continuous ceramic fiber  
8 ceramic matrix composites employing a thermoplastic  
9 photo-curable pre-ceramic polymer in which the component is  
10 shaped by a variety of standard composite fabrication  
11 techniques, such as filament winding, tape winding, and  
12 woven cloth winding, comprising steps of:  
13 a. passing ceramic fiber monofilament, tow, mat, or  
14 woven cloth through a solution of said thermoplastic  
15 photo-curable pre-ceramic polymer;  
16 b. applying ceramic fiber monofilament, tow, mat, or  
17 woven cloth to a moving flat substrate;  
18 c. using a compaction roller to press the thermo-

1 plastic pre-ceramic polymer coated ceramic fiber onto  
2 flat substrate;  
3 d. using photo-light of the ultraviolet, visible, or  
4 infrared light spectrum to induce cross-linking curing)  
5 of the photo-curable pre-ceramic polymer thereby  
6 rendering a thermoset polymer; and  
7 e. either partially or completely pyrolyzing the now  
8 cured pre-ceramic polymer matrix coated ceramic fiber  
9 material.

10  
11 51. A process for synthesizing ceramic matrix composites  
12 according to claim 50 in which the pre-ceramic polymer is  
13 poly(ethynyl)carbosilane.

14  
15 52. A process for synthesizing ceramic matrix composites  
16 according to claim 50 in which the pre-ceramic polymer  
17 yields an oxide ceramic upon pyrolysis.

18

1 53. A process for synthesizing ceramic matrix composites  
2 according to claim 50 in which the pre-ceramic polymer  
3 yields silicon nitride upon pyrolysis.

4  
5 54. A process for synthesizing ceramic matrix composites  
6 according to claim 50 in which the pre-ceramic polymer  
7 yields titanium carbide upon pyrolysis.

8  
9 55. A process for synthesizing ceramic matrix composites  
10 according to claim 50 in which the pre-ceramic polymer  
11 yields aluminum nitride upon pyrolysis.

12 56. A process for synthesizing ceramic matrix composites  
13 according to claim 50 in which the pre-ceramic polymer  
14 yields silicon carbide upon pyrolysis.

15  
16 57. A process for synthesizing ceramic matrix composites  
17 according to claim 50 in which the pre-ceramic polymer  
18 yields aluminum oxide upon pyrolysis.